Before the

Federal Communications Commission

Washington, DC 20554

In the Matter of Revision of Part 15 of the FCC's Rules Regarding Ultra-wideband Transmission Systems	ET Docket No. 98-153

Time Domain Corporation

Petition for Reconsideration

Time Domain Corporation ("Time Domain") hereby seeks limited reconsideration of the Commission's *First Report and Order* insofar as (1) the emissions limits set forth in Section 15.511 impair the ability of public safety entities to employ through-the-wall radar with sufficient reliability to make its use practical in tactical situations and (2) the rules effectively preclude firefighter tracking. For the reasons set forth below, the Commission should move promptly to revise the Part 15 ultra-wideband (UWB) regulations to remedy these concerns.

BACKGROUND

In this proceeding the Commission took initial conservative steps to authorize UWB operations on a Part 15 basis. Although Time Domain believes that the general limits applied to UWB devices are more conservative than is necessary to protect licensed services from harmful interference, Time Domain recognizes the extraordinary challenges and pressures confronting the Commission in this proceeding. As such, Time Domain applauds the Commission for its efforts and looks forward to participating in future proceedings that will examine further the appropriateness of the limits set forth in the *First Report and Order* as applied to UWB

generally. Time Domain supports the FCC's testing of UWB devices and the Commission's stated goal of reexamining the rules for UWB within six to 12 months from the effective date of the *First Report & Order*.

The Commission first approached UWB as a technology that holds great promise for public safety applications. Unfortunately, the limits adopted in the *First Report and Order* as applied to through-the-wall imaging using radar devices operated by public safety personnel will not provide for the sort of reliability needed in tactical situations. Moreover, the rules as adopted also will impair the effectiveness of any tracking systems developed to find firemen within burning buildings. These two limitations of the Commission's initial UWB decision can and should be remedied promptly upon reconsideration without the delay associated with further proceedings. Accordingly, in this petition, Time Domain urges the agency to revise the limits set forth in Section 15.511 so that the lives of innocent victims and those who would rescue them need not be further compromised. Equipment designed to meet this limited but extremely important application of through-wall radar devices should be authorized with broadband emissions levels of up to –41.3 dBm eirp. At the same time, firefighter tracking applications should also be allowed to operate at these same levels.

THE NEED FOR A MODIFIED LIMIT

No one should underestimate the technical challenges faced in trying to develop through-the-wall imaging systems for tactical deployment by public safety personnel. While this equipment would not be expected to be used frequently during a typical day, the limited instances of use will often involve life-threatening situations calling for reliable equipment that provides an accurate sense of the situation under assessment. Time Domain has developed such radar. It operates with a nominal center frequency of approximately 2 GHz and a –10 dB

bandwidth of approximately 2 GHz with a maximum eirp of approximately –15 dBm (i.e., total power across the entire -10 dB bandwidth) with a maximum power within any 1 MHz of -41.3 dBm. At 1610 MHz, the eirp of the signal from the RadarVision device is 5 dB below the Class B limit. As such, the device complies with the Class B general limits which constrain eirp above 960 MHz to –41.3 dBm/MHz or about *75 billionths of a watt.* The energy emitted from this device must penetrate at least one exterior wall, be reflected from objects up to 10 meters away on the other side of the wall, and then penetrate the same exterior wall again. Once the reflected signal is received, it must be processed to detect minute changes that can reflect movement as small as that associated with human breathing, small targets such as young children, or closely grouped individuals (e.g., two people in physical contact). Moving to higher frequencies and/or forcing the use of a signal with less bandwidth makes it unlikely that we will achieve the requisite performance.

The current rule requires that the UWB bandwidth (i.e. the –10 dB bandwidth) be contained within the band 1,990 – 10,600 MHz. Accordingly, the current through-the-wall radar authorized pursuant to a waiver would not qualify under Section 15.511. More importantly, however, this is not simply a matter expending further resources to develop ever more sophisticated signal processing capabilities. There are some genuine physical constraints that impair the ability of such a device to function if the UWB bandwidth must be contained within 1,990 – 10,600 MHz. First, the limit in Section 15.511 has the effect of requiring that the nominal center frequency to be located at3 GHz or above so that by the time the UWB pulse falls off in amplitude, the signal will be down 10 dB at 1.990 GHz.

Moving to a higher frequency of operation or reducing the system bandwidth in order to conform to the existing rules will reduce performance and reliability. In its comments to the

NPRM, Time Domain Corporation submitted data showing the absorption of RF signals for various material[1]. This data is reproduced below in Figure 1.

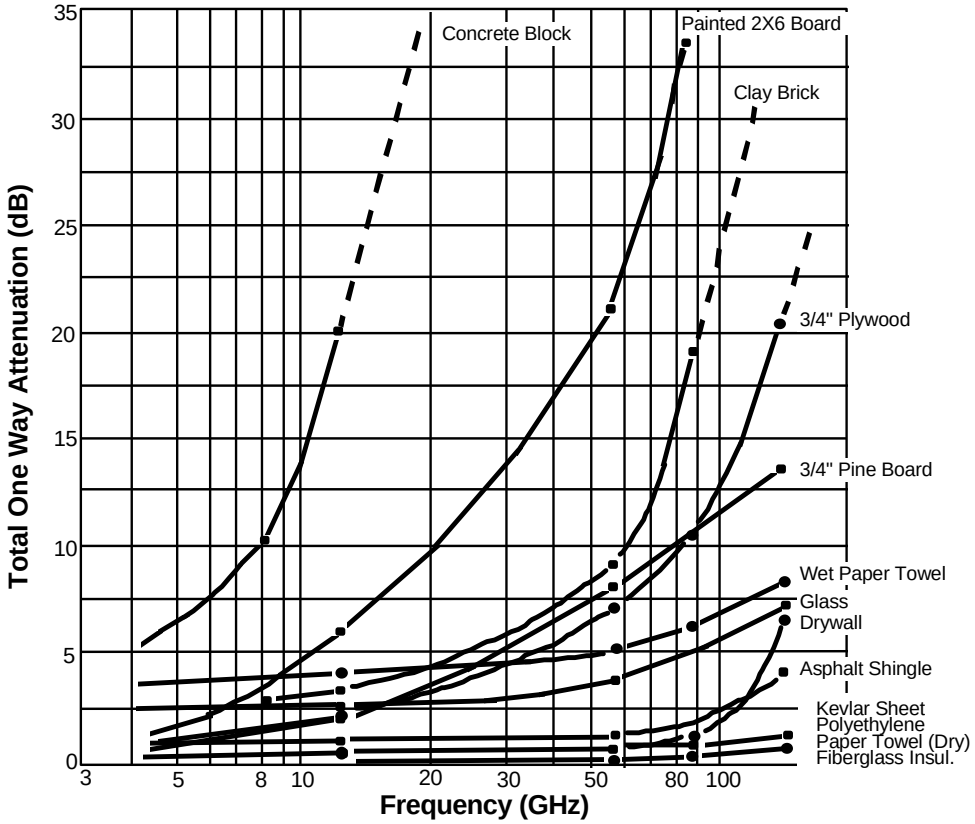

Figure 1. One way attenuation for various common construction materials.[2]

Time Domain Corporation testing has revealed that there is far more variability than suggested by this data. For example, Time Domain Corporation has measured some cinder block and found it to be nearly transparent at 2 GHz when dry, but when damp it reduced the signal by 10 dB. Another example is red brick. Our testing with brick produced in the Southeastern U.S.,

[1] Time Domain Corporation NPRM Comments, p. 13.

[2] Lawrence M. Frazier, Raytheon, "Radar Surveillance through Solid Materials", SPIE Photonics East conference, Enabling Technologies for Law Enforcement and Security, Boston, MA November 18 - 22, 1996. Paper 2938-20.

which is high in iron, found it attenuates a 2 GHz signal about 8 dB and is even worse at higher frequencies. This is further borne out by research conducted by NIST[3].

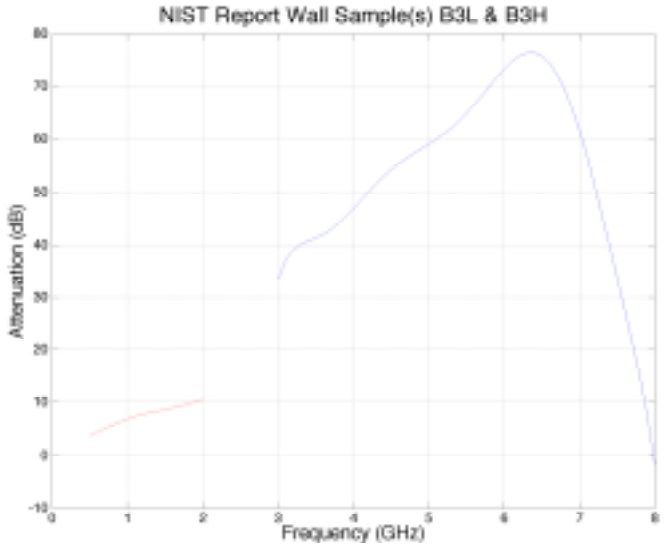

Figure 2. Attenuation of a sampling of a brick wall, 267 mm (10.5”) thick, as measured by NIST.4 (The NIST experiment did not measure the attenuation for frequencies between 2 and 3 GHz.)

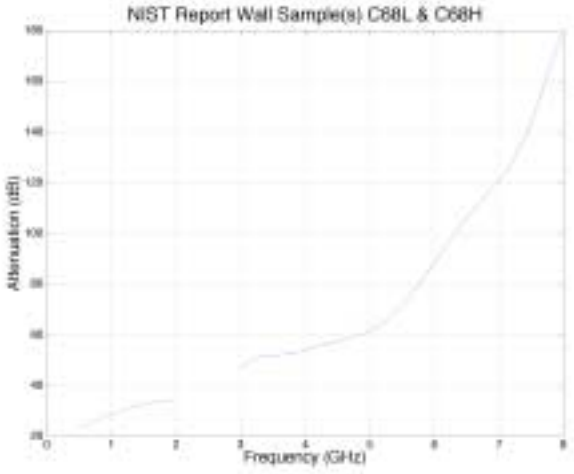

Figure 3. Attenuation of a sampling of a concrete wall, 203 mm (8”) thick, as measured by NIST.[5]

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[3] Stone, W. C., "Electromagnetic Signal Attenuation in Construction Materials," NISTIR 6055, NIST Construction Automation Program Report No. 3, October, 1997 (“NIST Report”).

[4] NIST Report, pages 63 – 67.

Even though the loss through a single layer of wall may seem small, through-wall radar signals will pass though these layers twice. These "small" losses add up.

In the case of a brick wall that was half as thick as shown in Figure 2 (i.e. 5.25" – equivalent to a façade of brick over a wooden frame – a typical construction technique in the Southeastern U.S.), the additional two-way attenuation would be 26 dB. For a two-way reduction in SNR of 26 dB in the 3-5 GHz band versus the 1-3 GHz band, the range would be reduced by -26/4 = -6.5 dB. This is a reduction in range of 77%, which reduces the nominal detection range from 30 feet to 6.7 feet. Therefore, it becomes apparent that any movement from lower frequencies up to the 3-5 GHz (or higher) band will make the radar highly ineffective to perform its mission against this kind of wall material.

If it were a 4" thick concrete wall, the two way attenuation would be 13 dB. For a two-way reduction in SNR of 13 dB in the 3-5 GHz band versus the 1-3 GHz band, the range would be reduced by -13/4 = -3.25 dB. This is a reduction in range of 53% which reduces the nominal detection range from 30 feet to 14.2 feet.

Our work with SWAT officers shows that if the imaging system is not reliable beyond twenty feet, the system is not useful.[6] The reason for this range is that police officers want the equivalent of at least a two room standoff distance for safety. With a room width of ten to twelve feet, the range must be twenty to twenty four feet.

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[5] NIST Report, pages 111 – 115.

[6] Time Domain personnel have spent many hours with public safety officers to develop a thorough requirements specification. Among those with whom we have worked to develop our insights into the marketplace are: Los Angeles County Sheriffs Department, Houston Police Department, and Chesterfield County Virginia Police.

If public safety officials cannot rely on through-the-wall imaging to provide a reliable sense of what they may encounter, the technology will be useless for this application. Absent the change requested, Time Domain believes that reliable through-the-wall radar units may still be developed, but only for use by by personnel that may be able to operate the devices at higher power than permitted under the *First Report & Order* -- namely the military, federal officials and for public safety officers in foreign countries. Of course, the irony and the tragedy of such a result is that state and local law enforcement and firefighters are by far the personnel most often called upon to handle emergency situations. At least for civilian public safety applications, such a dichotomy should not exist.

The *First Report and Order* also raises concerns as to the feasibility of developing reliable systems to track and find firefighters within burning buildings. The wide bandwidth of UWB makes it possible to determine the distance from one UWB device to an associated receiver with great precision, often down to a matter of a few centimeters or less. Narrowband signals, which are subject to far greater deleterious effects of multipath distortion do not afford this capability. Indeed, while tracking can be done with narrowband signals, the approach involves far less precision and becomes a classic exercise in radio direction finding without the ability to provide a precise readout of the range to the lost firefighter. In an environment in which seconds can mean the difference between life or death, firefighters should have access to technology that can provide precise information as to their locations within burning buildings. It is well within the emerging state of the art for systems to be developed that would, for example tell a firefighter using computer generated voice prompts that another firefighter was “eight meters behind you” or convey that a fallen fire fighter is “nine meters to your left side.” Just as wall penetration can be critical to police officers using through-the-wall radar to gain a sense of

the situation before making a forced entry, firefighters will need UWB systems that can function with signals that penetrate multiple interior walls and even one exterior wall.

Firefighter tracking applications, however, were compromised greatly in the *First Report and Order*. First, even the exiting limits of Section 15.511 do not apply to firefighter tracking because the definition of *imaging system* in Section 15.503(c) specifically excludes "systems designed to detect the location of tags."[7] Upon reconsideration the Commission should revise the regulations to specify an exception so that tags used to locate firefighting personnel at the scene of a fire and in training can be operated at the Class B general limits. These same provisions should also allow for data to be transferred to among the tags so that critical information such as respiration and temperature associated with the firefighter wearing the tag can be conveyed without having to add another radio firefighter's equipment load. Indeed, with UWB, the same signal being used for tracking can also carry this information as noise coded modulation so as to make the signal indistinguishable from a signal employed solely for tracking.

Second, the same propagation concerns that impair the ability of through-the-wall radar to function reliably through multiple walls threaten the feasibility of firefighter tracking systems. These systems, too, must be able to function through multiple walls or even rubble in the case of a fallen firefighter. Like through the through-wall radar used by police officers, these systems would be deployed in limited situations and then only by trained personnel who would use the systems for lifesaving applications. Accordingly, the same emissions limits that would apply to public safety through-the-walls radar should be applied to firefighter tracking.

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[7] Indeed, it is arguable that firefighter tracking systems would be relegated to operation under Section 15.519 pertaining to "hand held" peer-to-peer systems. These limits would preclude any realistic operation because of short range, difficulty penetrating walls, and the requirement that the device generally be hand held.

THE APPROPRIATE LIMIT

The Class B limits are appropriate above 1.610 GHz for public safety applications involving through-the-wall imaging and firefighter tracking. The likelihood of operations of the sort proposed herein causing harmful interference is exceedingly remote. In its comments and replies in this proceeding Time Domain analyzed the data put forth by the various studies submitted for the record.[8] None of those studies when examined in light of realistic deployment scenarios reveals a credible threat of harmful interference to licensed services from the limited number of systems that would be deployed and operated even in major metropolitan areas under the limits sought in this petition for reconsideration. Rather than basing a finding on the total record, the *First Report and Order* simply relied on NTIA's positions. Over twenty years of experience with the Class B limits plus out-of-band limits for licensed but ubiquitously deployed radio services that are less rigorous than the Class B limits should give a high measure of confidence that the limits requested on reconsideration are reasonable for public safety use of UWB as described herein.

Even with the application of the Class B limits to this very limited set of UWB operations, the Commission could still require an additional 10 dB of attenuation for narrowband emissions within the GPS bands of 1164 – 1240 and 1559 – 1610 MHz to reduce the possibility of effects from spectral lines falling within these bands. Indeed, because the overwhelming majority of these operations would be indoors, GPS and other licensed services would benefit from the additional protection afforded by building attenuation.

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[8] Time Domain Corporation NPRM filings: Comments dated February 23, 2001 (Selected non-GPS Federal Systems); Reply Comments dated March 12, 2001 (Selected non-GPS Federal Systems); and Reply Comments dated May 10, 2001 (GPS).

Moreover, none of the submissions to the record present a logical rationale for objection to the utilization of UWB by public safety personnel for their life-saving applications. None has shown how such limited use would endanger any other safety-of-life application.

CONCLUSION

The Commission correctly characterized the *First Report and Order* as a cautious first step. Unfortunately, in taking that step, the Commission adopted limits that will generally preclude the application of UWB technology for law enforcement see-through-the-walls radar and for firefighter tracking. In this limited Petition for Reconsideration Time Domain urges the Commission to set the limits for these two very constrained applications so that the lives of public safety personnel and those they seek to protect need not be compromised by unnecessarily low signal levels.

Respectfully,
Time Domain Corporation

By_____
/s/ Paul Withington
Vice-President
Cummings Research Park
7057 Old Madison Pike
Huntsville, AL 35806

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